Testimony of Clifton A. Baile
Distinguished Professor & Georgia Research Alliance Eminent Scholar
in Agricultural Biotechnology
444 Edgar L. Rhodes Center for Animal and Dairy Science
University of Georgia
Athens, GA 30602-2771

Before the
Subcommittee on Conservation, Credit, Rural Development, and Research
Committee on Agriculture
U.S. House of Representatives

Georgia Center for Continuing Education
Athens, Georgia
March 29, 2004

Thank you for the opportunity to make a statement regarding Federal support for agricultural research with special emphasis on the roles of basic research. Clearly, the United States has led the world in many sectors of the research community, and certainly agriculture has been one of these sectors.

I would like to comment on four examples of the role of basic research in which I have had an opportunity to participate. Clearly, biotechnology is changing the way we think about biomedical and agricultural problems and solutions. We have tools available that none of us could have imagined 25 years ago.

Like many biologists, I joined the biotechnology efforts in the early eighties just after there was some definition of what was meant by this new descriptor. I learned first hand how basic research impacts agriculture while directing a group of several hundred people working to develop the first animal biotechnology product to enter the market. As has often been the case, the basic research for this application had been funded for biomedical research purposes. In this case, hundreds of millions of dollars had been spent to discover how to engineer microbes to synthesize complex proteins in a matter of hours. Using traditional chemistry, this kind of process would previously have required teams of people many years. Those of us working in the agriculture sector took this knowledge and developed a product, Posilac or bovine somatotropin, which has now been marketed successfully for over ten years. Only through the federal support of basic research would this ever have been possible. Many new biotechnology tools required for such applications came directly from federally-sponsored basic research projects. This product for dairy cows has required production plants that annually produce many times more protein drug than any other plant in the world, for either human or animal applications. For example, capacities exist to produce over 50 tons of this protein annually now, and the largest of these production plants is located in Georgia. By applying many of the basic research tools and processes, this complex protein is produced under Good Manufacturing Practices and marketed at a retail cost of about $10 per gram. This is less than one-thousandth of the cost of similar products sold for medicinal purposes, due to both volume of production and extraordinarily efficient production processes.

A second truly amazing application of basic research to agricultural problems has been the production of and the delivery to the market place of genetically modified plants. Thousands of federally-funded projects generated the biotechnology tools that were applied to move genetically modified crops from the discovery stages to where they are now--producing nearly 20% of the world's cotton, soybean, corn and canola. The adaptation rate of these revolutionizing crops over the past eight or nine years has been unprecedented. During the early 1980s, scientists like Dr. Michael Adang, now at the University of Georgia, had much to learn in order to engineer plants to produce microbial toxins, such as Bacillus thuringiensis (BT). Dr. Adang, the inventor on numerous patents in this field, and others applied the rudimentary information available at the time to modify the codes for protein synthesis by microbial genes so that they could be used by plants to produce high levels of these unique and very specific toxins for selected insects. The applications of these biotechnology tools and innovations will continue to change crop production practices and productivity in extremely positive ways for the unforeseeable future. Clearly, these tremendous gains in crop productivity were possible due to the investments by society in basic research, with results of helping provide food for the several billions yet to be added to the world population.

Biotech Crops

Billion Hectares

Crop	Global Area	Biotech Area	% Biotech
Soybean	**72**	**33**	**46**
Cotton	**34**	**7**	**20**
Canola	**25**	**3**	**11**
Corn	**140**	**10**	**7**
Total	**271**	**53**	**19**

A third example of basic research applications to developments in agriculture is the new technology of livestock cloning. This is another area in which I have personally been involved, helping to make Georgia a leader in this area. The understanding of embryology and developmental biology has been enhanced by billions of dollars spent by both the federal government and private industry. The very basic research in these areas has been fueled by the need to understand embryonic and genetic diseases, human reproduction, cancer, etc. This basic research has led to the development of the remarkable ability to reproduce animals with high-value genetics through cloning. The cloning of plants has been practiced by plant breeders for centuries, and animal cloning, although much more complex, has similar applications for enhancing highly desirable genetic traits, such as disease resistance. Application of this technology is still in the early stages, but it offers tremendous potential for improving productivity in animal agriculture and also for animal genetic preservation. Dr. Steve Stice, an internationally known University of Georgia scientist who led this team effort, produced KC, a calf cloned from kidney cells collected from a carcass after it had been in a typical meat cooler for 48 hours. This technology has many potential applications for the selection and proliferation of very superior and proven livestock genetics. Dr. Stice and I, with others, founded a Georgia-based company, ProLinia, Inc., that is now merged with ViaGen, Inc., which is in the process of commercializing this livestock cloning technology.

Eight cloned calves are introduced to the media at the University of Georgia's new Animal and Dairy Science Arena (6/27/01).

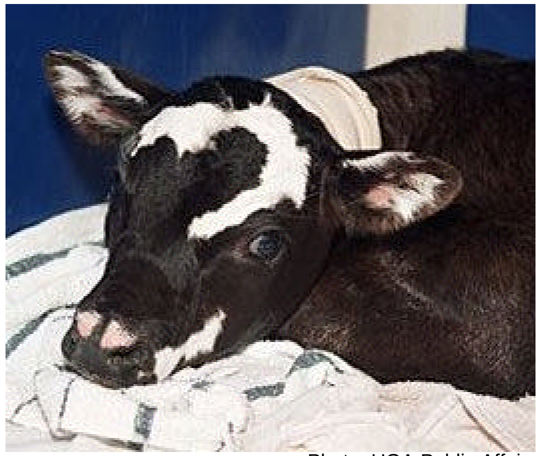

Photo: UGA Public Affairs

"K.C." (for kidney cell), the world's first calf cloned from the cells of a slaughtered cow, represents a breakthrough in cloning technology.

The fourth and final example is associated with a technology that is believed by many to be the greatest scientific feat yet accomplished by man, sequencing of the human genome. Most of the technology and knowledge base for this huge endeavor was developed from thousands of publicly-funded basic research grants. While a University of Georgia professor, I happened to be consulting for Celera Genomics when the sequencing of the human genome was being done. As the human genome sequencing was nearing completion, there was a window of opportunity for animal agriculture to take advantage of the unused capacity. Decisions were made to sequence three livestock genomes using the expertise, hardware and software that were in place for sequencing the human genome. Amazingly, thanks to the previous genomes having been completed, the additional three animal genomes were sequenced in a matter of months and at a fraction of the cost. These genomes are starting to be used by the private sector, for example, by MetaMorphix, Inc., a company with which I work closely (as a member of the Board of Directors, along with a former Secretary of Agriculture, Jack Block). These applications are likely to have a greater impact on animal genetics and productivity than any previous single technology. The genomes and the associated large sets of single nucleotide polymorphisms allow for a paradigm shift in the way livestock can be managed to produce the highest quality of meat at the lowest cost, and with a built-in, molecular-based identification system. Applications of combining livestock genomics and cloning are expected to revolutionize animal productivity and will likely make it possible to meet the demands of high quality food and fiber for an ever-increasing human population. These novel technologies will soon be in the market place, and due to publicly financed basic research primarily for medicinal purposes, animal agriculture will reap many benefits.

I strongly support the funding of basic research to make possible the application of new technologies to agriculture for continued increased efficiency of food and fiber production. These changes in productivity enhancement are critical to continue to meet the needs of human populations, and the pressure is ever increasing due to additional demands for improved product quality and environmental issues. Our society deserves to be congratulated for our past funding of the strongest federally-financed scientific infrastructure found in the world.